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Spatial Nucleation and Crystal Growth

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Introduction

This report summarizes the progress of research efforts under NASA grant NsG-663 during the six month period from June thru November 1964 inclusive. The central aims of this grant are to obtain experimental information pertinent to the process of particle formation under the conditions extant in interplanetary and interstellar space, and to use this experimental information to formulate a coherent theory of the origin of such particles.

Progress to Date

In the present reporting period, progress has been made in three of the proposed areas of attack, namely the construction of an improved ultrahigh vacuum molecular beam system for gas-solid interaction studies, experimental nucleation studies at low pressures and measurement of the thermal accommodation of metal vapors at solid surfaces.

An all metal, ion pumped vacuum system in which molecular beam studies will be carried out has been designed and fabricated and is currently being assembled and tested. A power supply and temperature controller for an electron beam heated molecular beam source assembly has been built and successfully tested. An electron gun assembly to be used in surface ionization studies

in the vacuum chamber is under construction. New electrical controls for the mass spectrometer detector to be used on this system have been built and tested.

Preliminary results have been obtained for the nucleation of selenium from the vapor onto pyrex glass. This work is being done using a modification of the technique previously used for similar studies on zinc and cadmium (1). Results to date indicate that the supersaturation vs temperature relation previously observed for zinc and cadmium is also followed in the case of selenium. In addition, it has been observed that the selenium always condenses as a liquid, even at temperatures as much as 80°C below the equilibrium melting point. Further studies are currently under way in which the range of attainable under-coolings will be increased in the hope of delineating the limits of this non-equilibrium phase nucleation.

A small glass ultrahigh vacuum system has been constructed in which measurements will be made of the thermal accommodation coefficient of metal vapors on a pyrex glass surface. Fabrication of this system has just been completed, and it is currently undergoing preliminary testing.

Prognosis

During the next reporting period, work in the three areas mentioned above will be continued. Mass spectrometric studies will be begun on the metal molecular beam system. Further data on the nucleation of selenium will be gathered. Operation of the thermal accommodation system will begin.

References

Hudson, J. B., J. Chem. Phys. 36, 887 (1962).